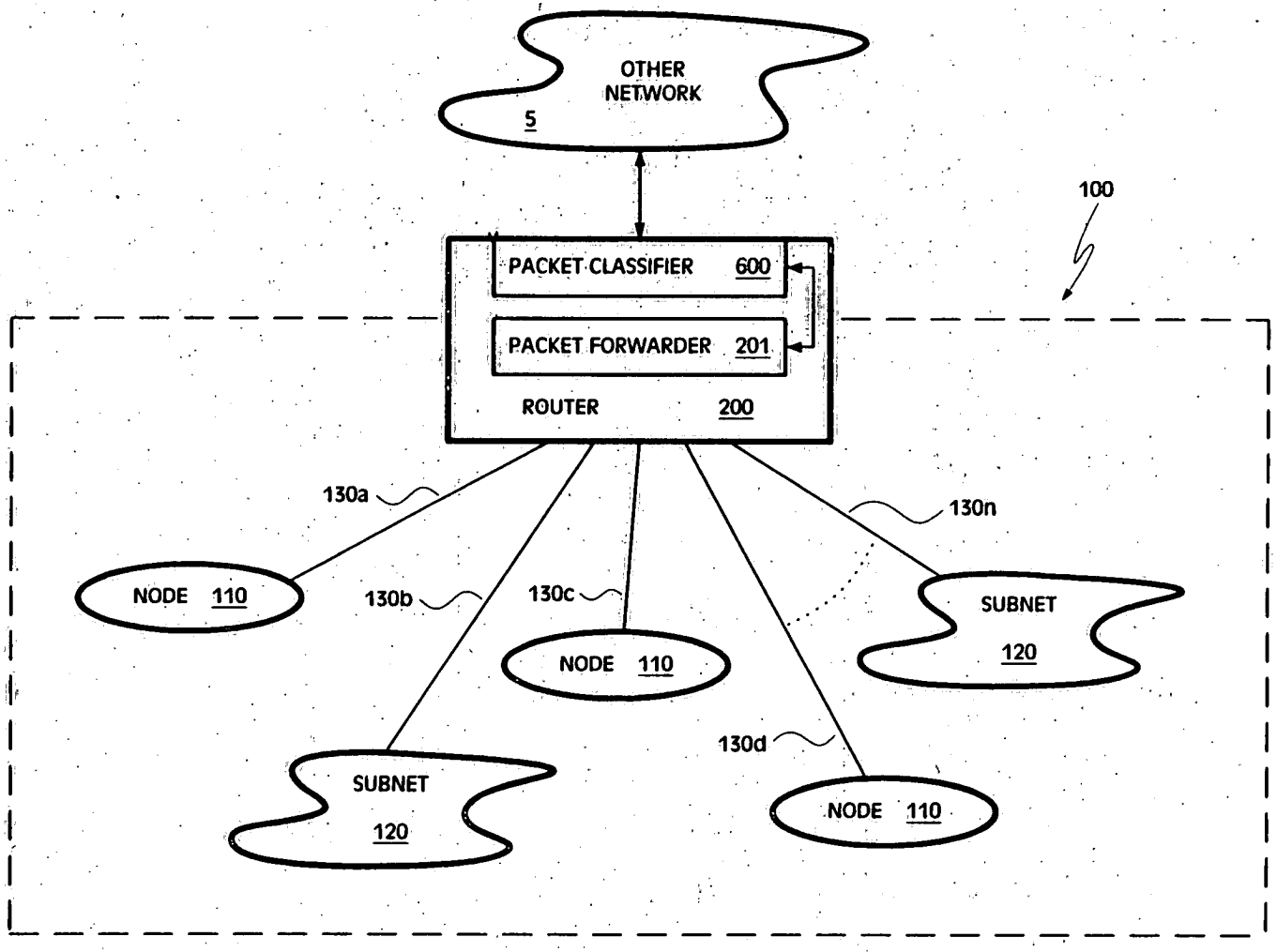
OTHER
NETWORK
5
100
PACKET CLASSIFIER 600
PACKET FORWARDER 201
ROUTER 200
130a
130b
130c
130d
130n
NODE 110
NODE 110
NODE 110
SUBNET
120
SUBNET
120

FIG. 1

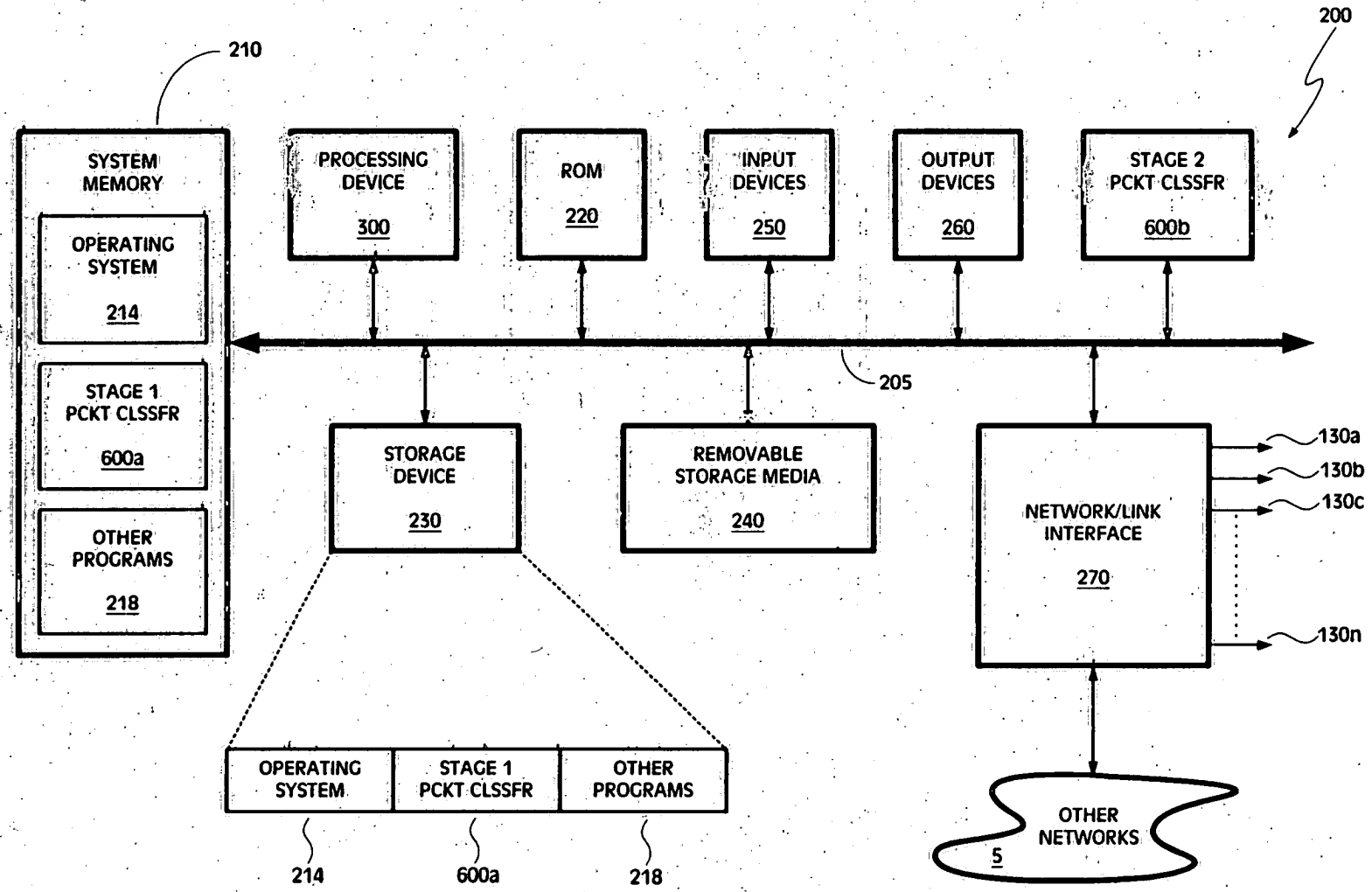
200
210
SYSTEM MEMORY
OPERATING SYSTEM 214
STAGE 1 PCKT CLSSFR 600a
OTHER PROGRAMS 218
PROCESSING DEVICE 300
ROM 220
INPUT DEVICES 250
OUTPUT DEVICES 260
STAGE 2 PCKT CLSSFR 600b
205
STORAGE DEVICE 230
REMOVABLE STORAGE MEDIA 240
NETWORK/LINK INTERFACE 270
130a
130b
130c
130n
OPERATING SYSTEM
STAGE 1 PCKT CLSSFR
OTHER PROGRAMS
214
600a
218
OTHER NETWORKS
5

FIG. 2

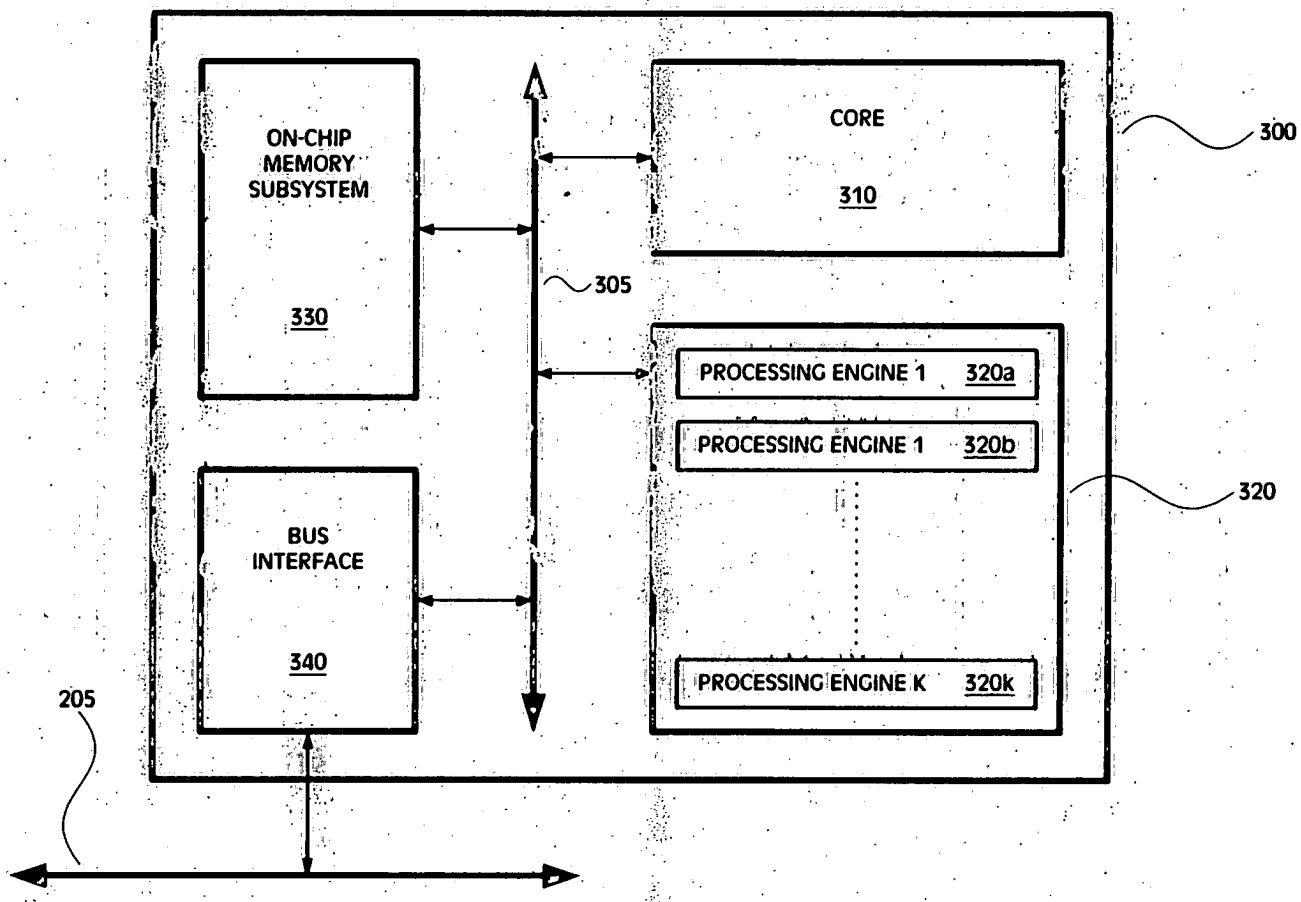

FIG. 3 (PRIOR ART)

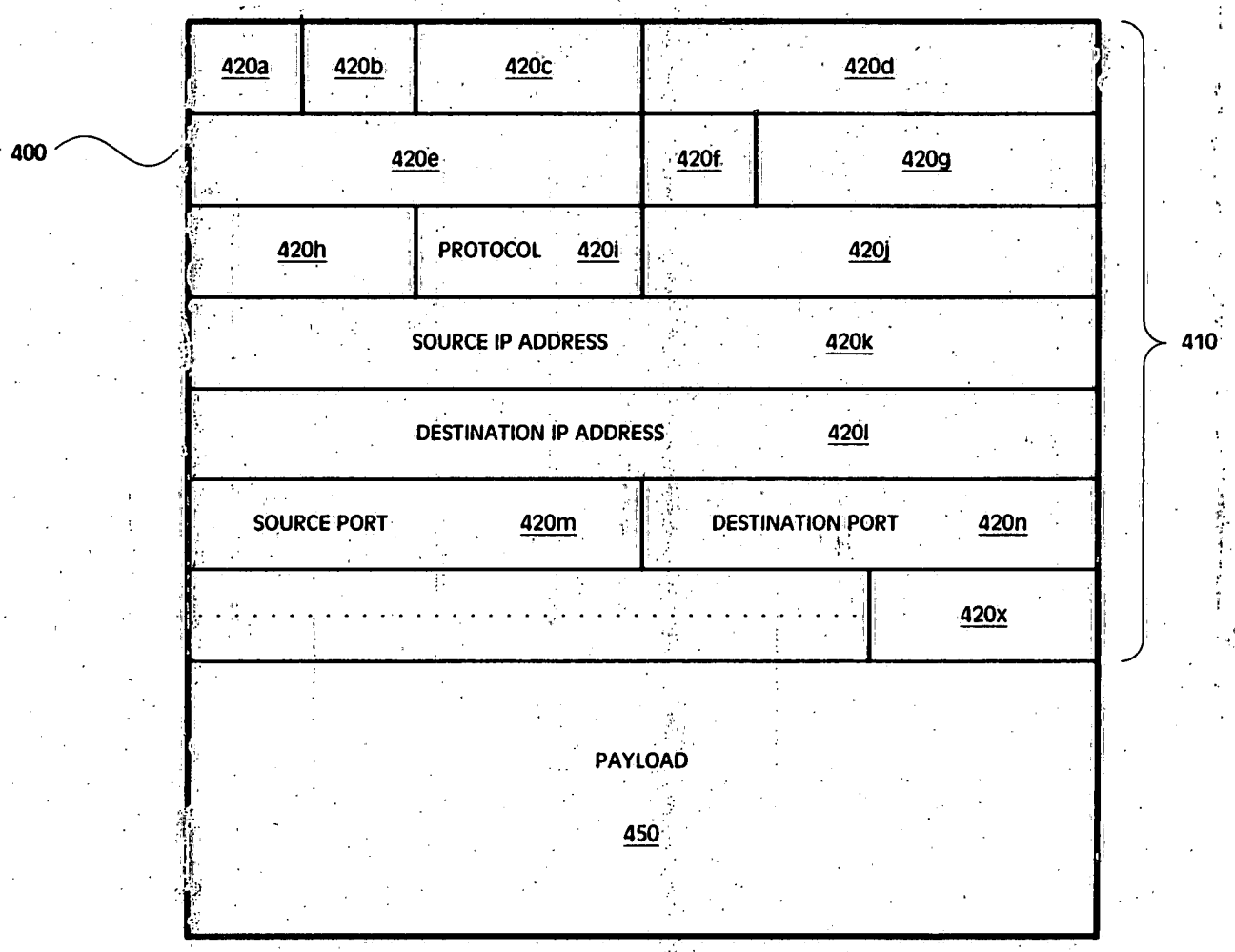

FIG. 4 (PRIOR ART)

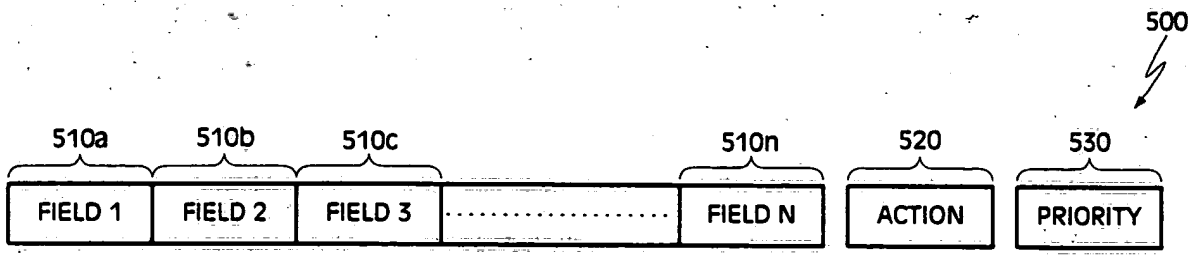

FIG. 5A (PRIOR ART)

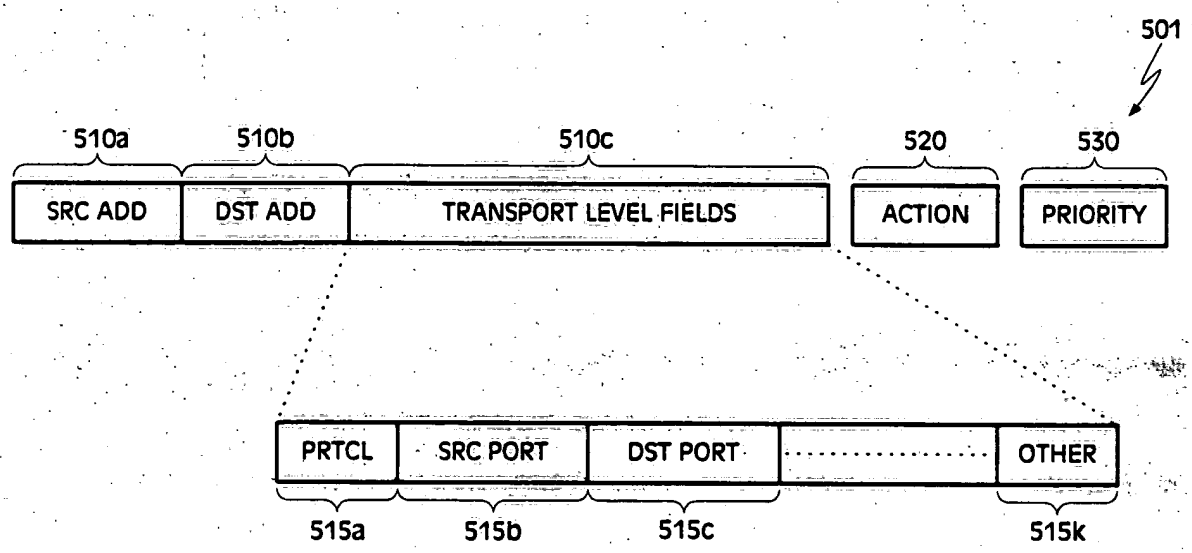

FIG. 5B (PRIOR ART)

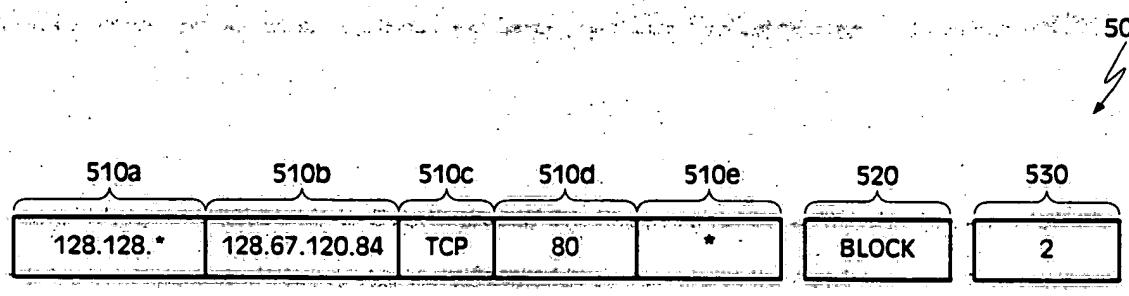

FIG. 5C (PRIOR ART)

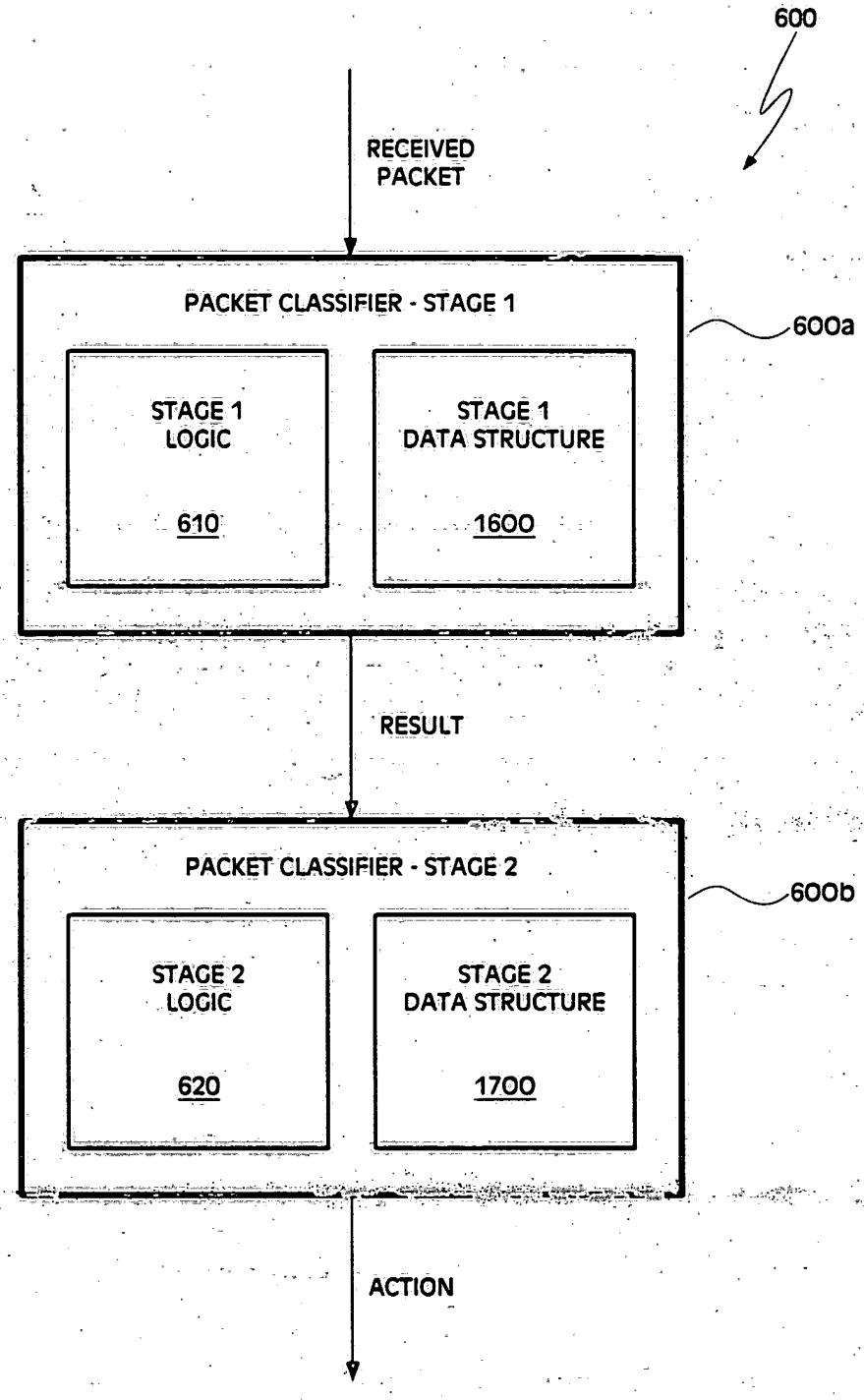
600
RECEIVED PACKET
PACKET CLASSIFIER - STAGE 1
600a
STAGE 1 LOGIC
610
STAGE 1 DATA STRUCTURE
1600
RESULT
PACKET CLASSIFIER - STAGE 2
600b
STAGE 2 LOGIC
620
STAGE 2 DATA STRUCTURE
1700
ACTION

FIG. 6

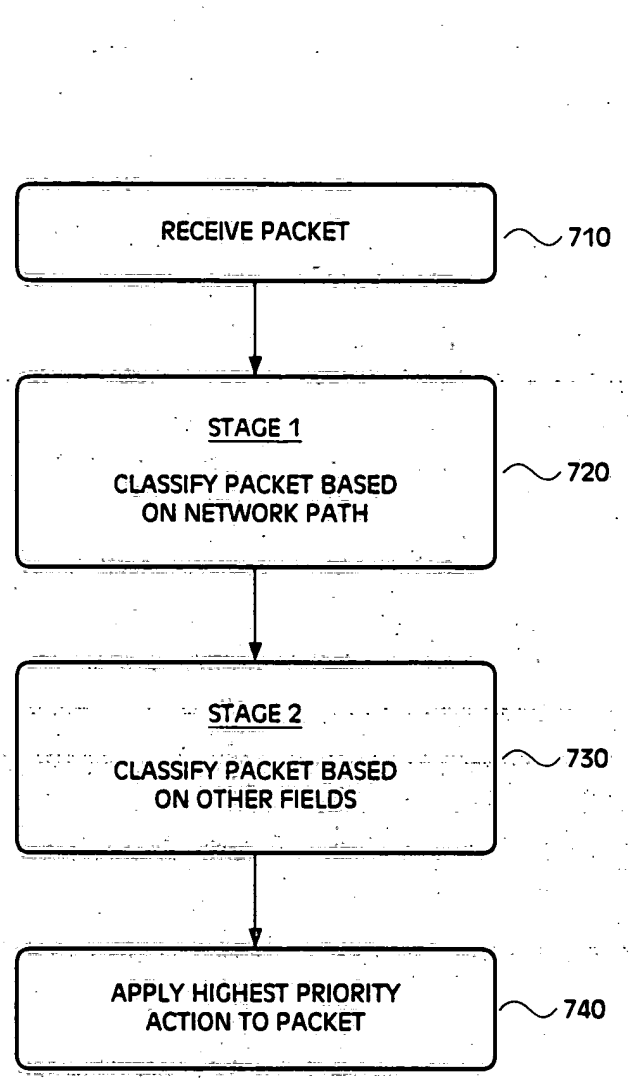
700
RECEIVE PACKET
710
STAGE 1
CLASSIFY PACKET BASED ON NETWORK PATH
720
STAGE 2
CLASSIFY PACKET BASED ON OTHER FIELDS
730
APPLY HIGHEST PRIORITY ACTION TO PACKET
740

FIG. 7

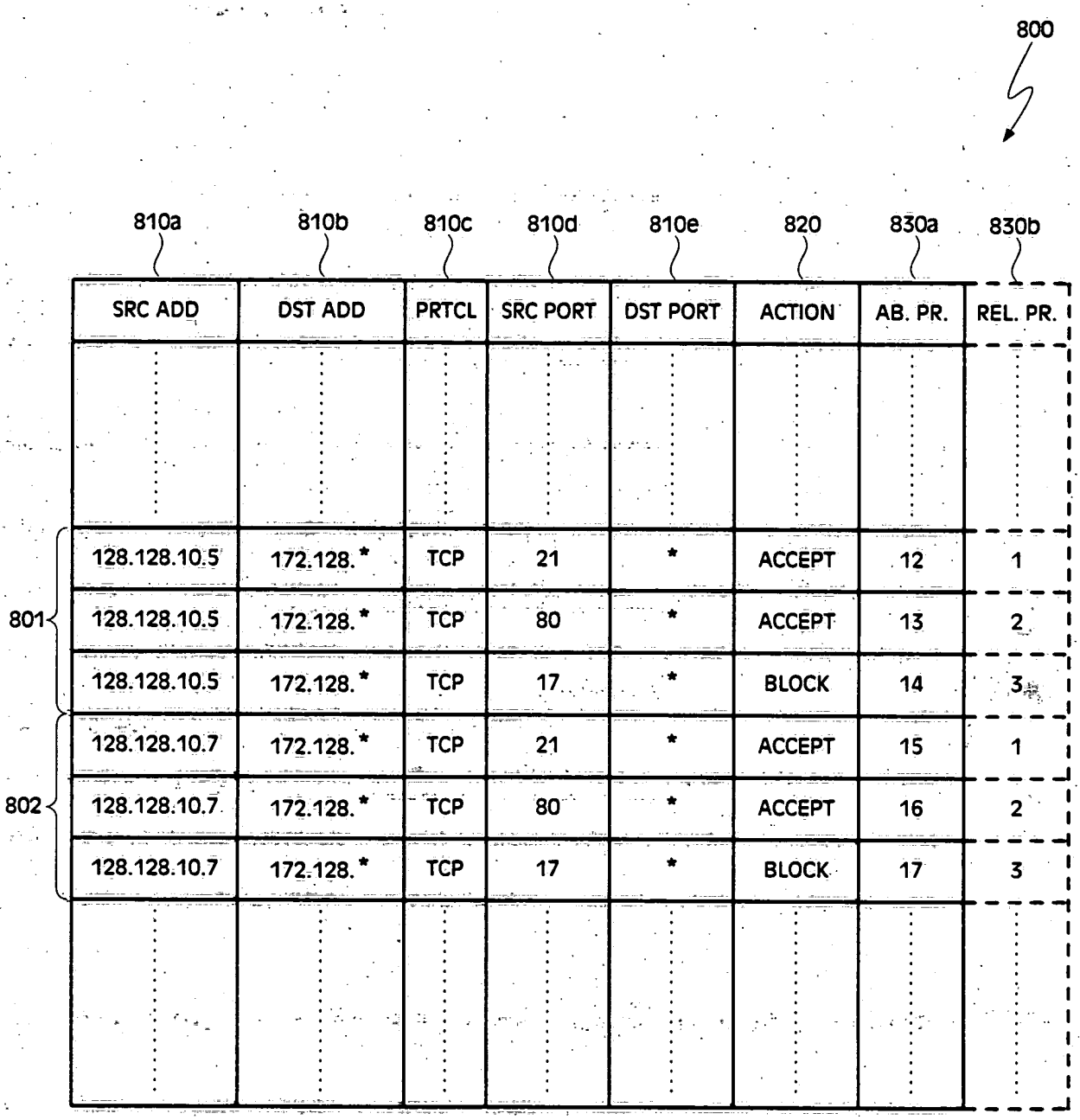
800
810a
810b
810c
810d
810e
820
830a
830b
SRC ADD
DST ADD
PRTCL
SRC PORT
DST PORT
ACTION
AB. PR.
REL. PR.
801
128.128.10.5
172.128.*
TCP
21
*
ACCEPT
12
1
128.128.10.5
172.128.*
TCP
80
*
ACCEPT
13
2
128.128.10.5
172.128.*
TCP
17
*
BLOCK
14
3
802
128.128.10.7
172.128.*
TCP
21
*
ACCEPT
15
1
128.128.10.7
172.128.*
TCP
80
*
ACCEPT
16
2
128.128.10.7
172.128.*
TCP
17
*
BLOCK
17
3

FIG. 8

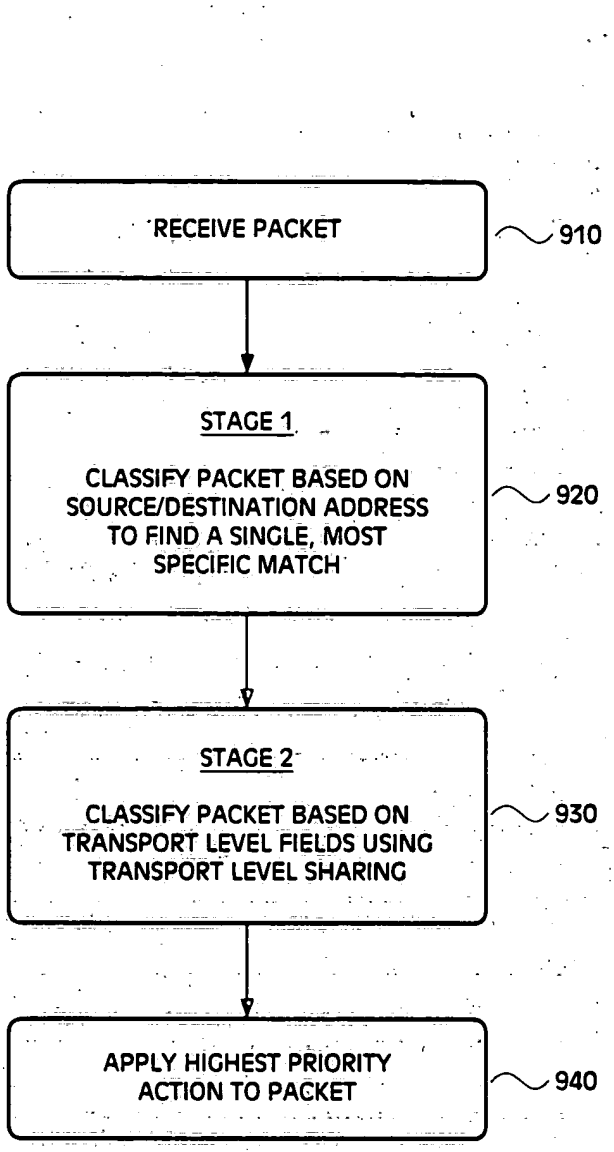
900
RECEIVE PACKET
910
STAGE 1
CLASSIFY PACKET BASED ON SOURCE/DESTINATION ADDRESS TO FIND A SINGLE, MOST SPECIFIC MATCH
920
STAGE 2
CLASSIFY PACKET BASED ON TRANSPORT LEVEL FIELDS USING TRANSPORT LEVEL SHARING
930
APPLY HIGHEST PRIORITY ACTION TO PACKET
940

FIG. 9

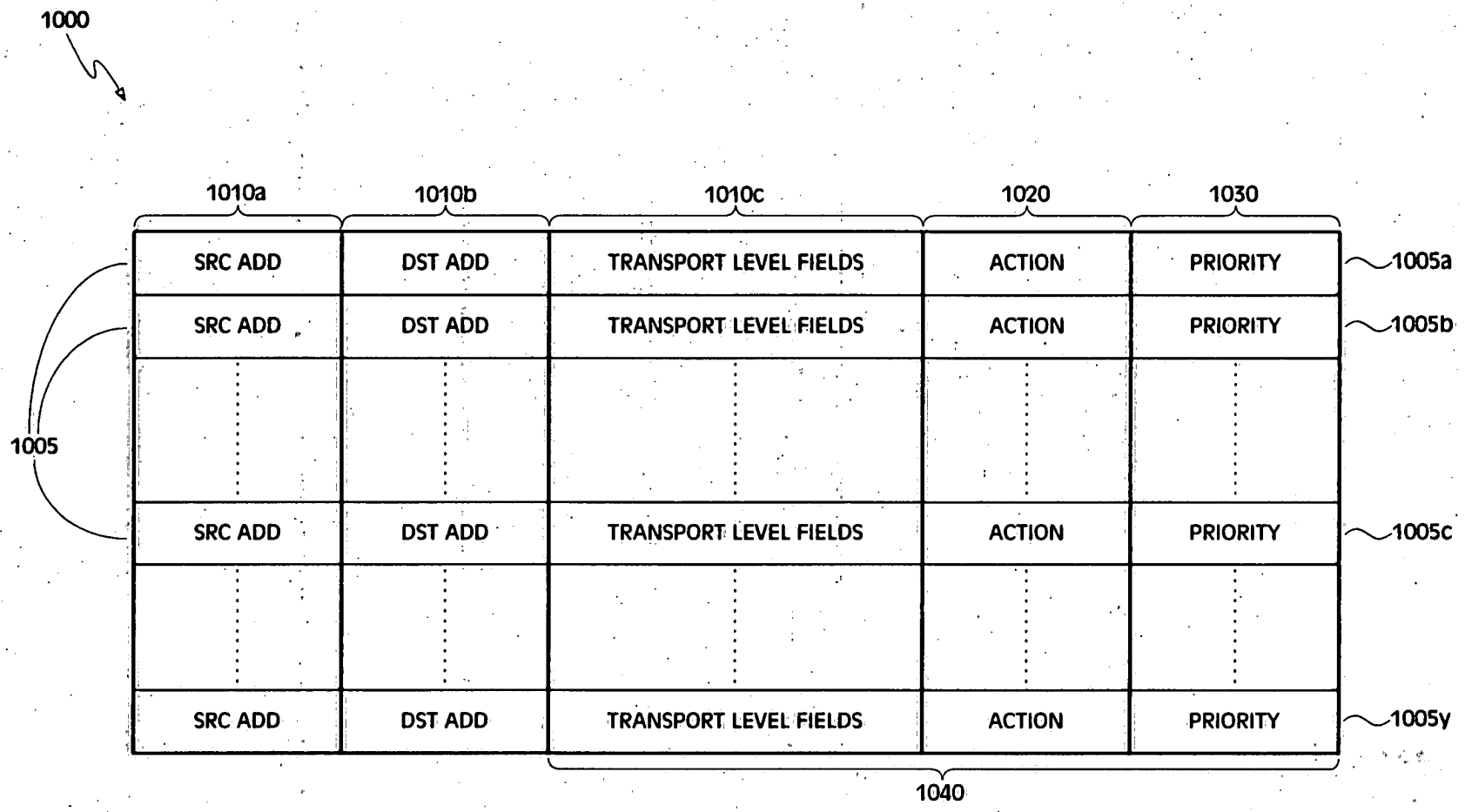
1000
1010a
1010b
1010c
1020
1030
SRC ADD
DST ADD
TRANSPORT LEVEL FIELDS
ACTION
PRIORITY
1005a
1005b
1005c
1005y
1005
1040

FIG. 10

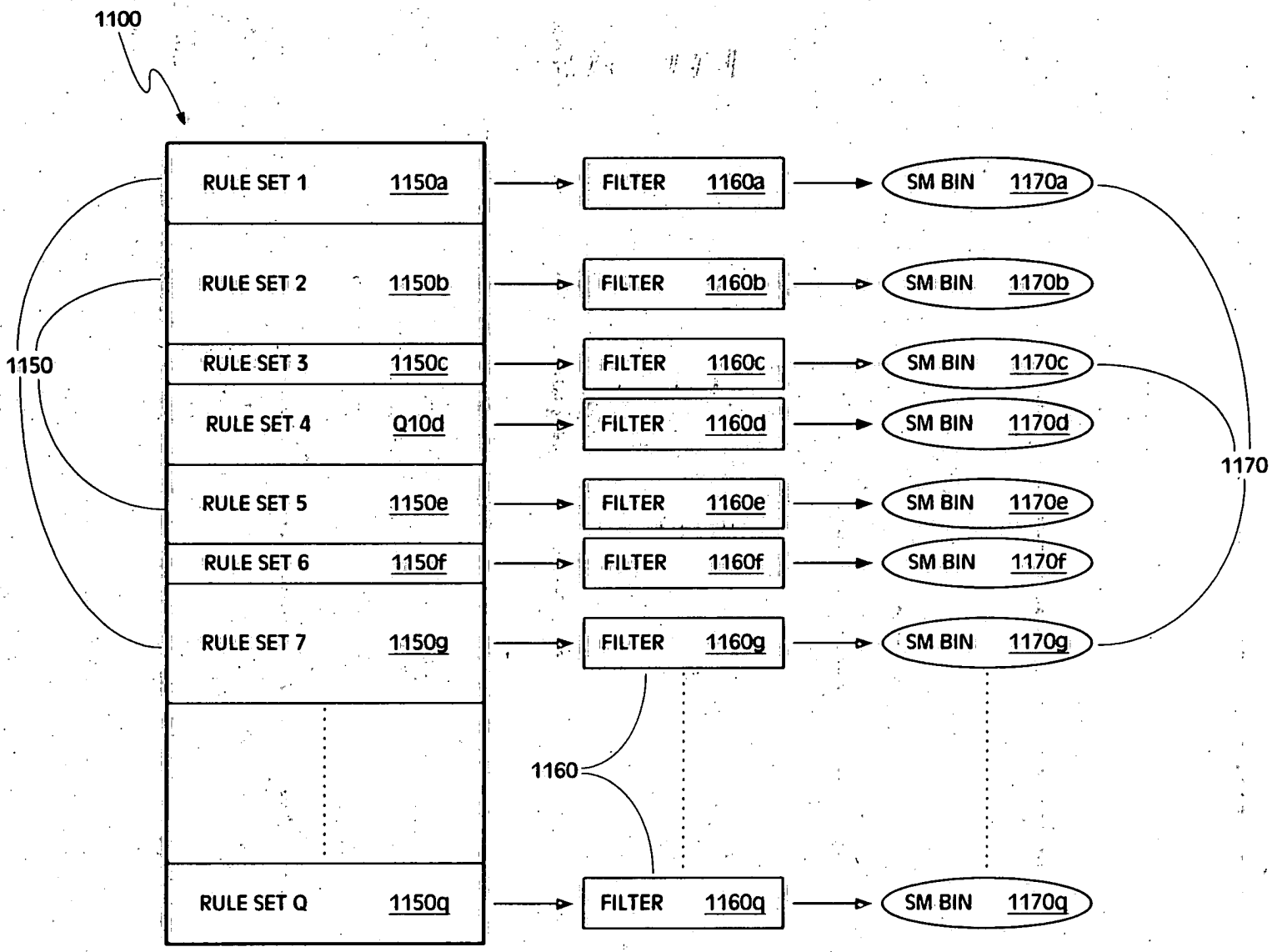
1100
RULE SET 1 1150a
RULE SET 2 1150b
RULE SET 3 1150c
RULE SET 4 Q10d
RULE SET 5 1150e
RULE SET 6 1150f
RULE SET 7 1150g
RULE SET Q 1150q
1150
FILTER 1160a
FILTER 1160b
FILTER 1160c
FILTER 1160d
FILTER 1160e
FILTER 1160f
FILTER 1160g
FILTER 1160q
1160
SM BIN 1170a
SM BIN 1170b
SM BIN 1170c
SM BIN 1170d
SM BIN 1170e
SM BIN 1170f
SM BIN 1170g
SM BIN 1170q
1170

FIG. 11A

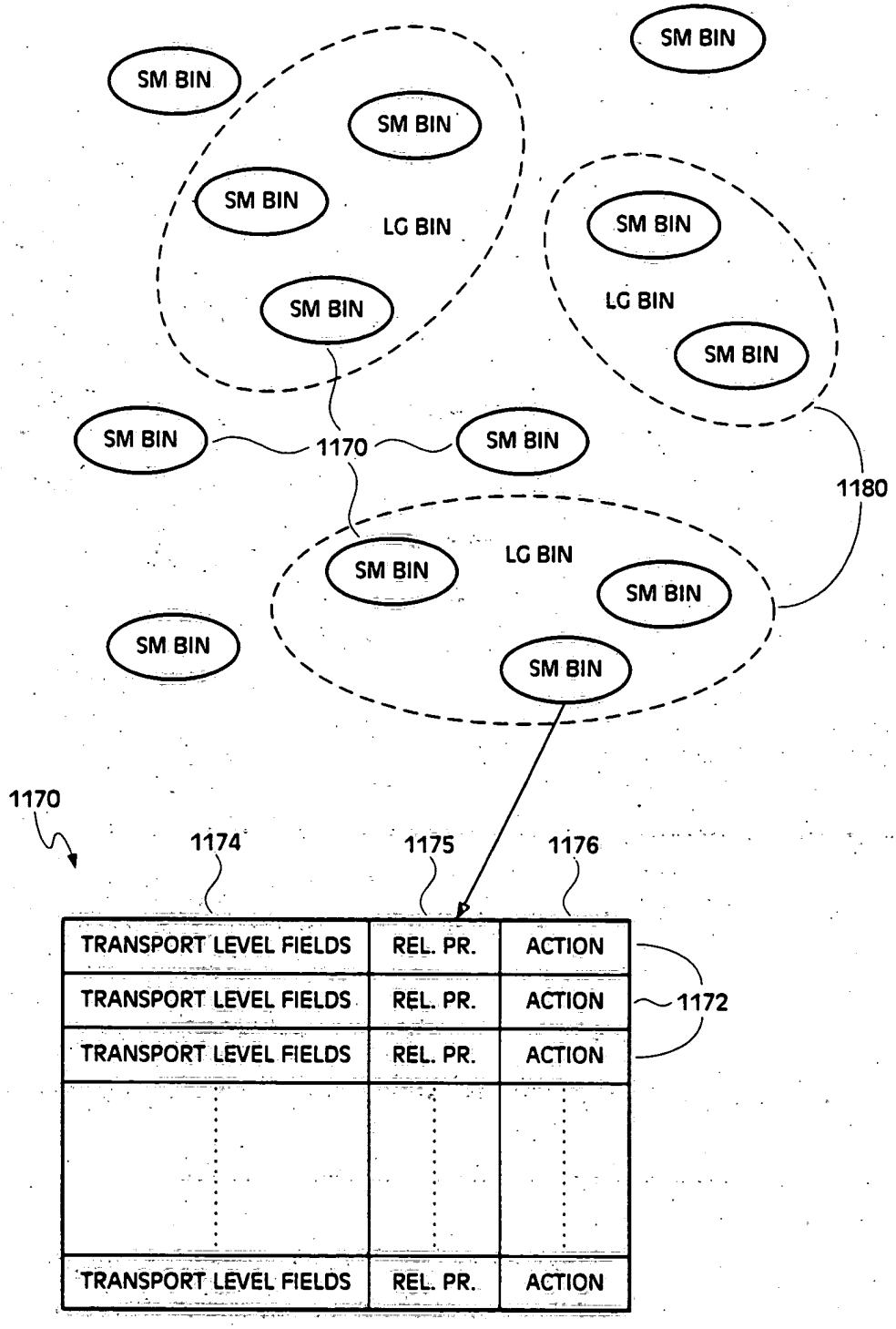
SM BIN
SM BIN
SM BIN
SM BIN
LG BIN
SM BIN
SM BIN
SM BIN
LG BIN
SM BIN
SM BIN
1170
SM BIN
1180
SM BIN
LG BIN
SM BIN
SM BIN
SM BIN
1170
1174
1175
1176
TRANSPORT LEVEL FIELDS
REL. PR.
ACTION
TRANSPORT LEVEL FIELDS
REL. PR.
ACTION
1172
TRANSPORT LEVEL FIELDS
REL. PR.
ACTION
TRANSPORT LEVEL FIELDS
REL. PR.
ACTION

FIG. 11B

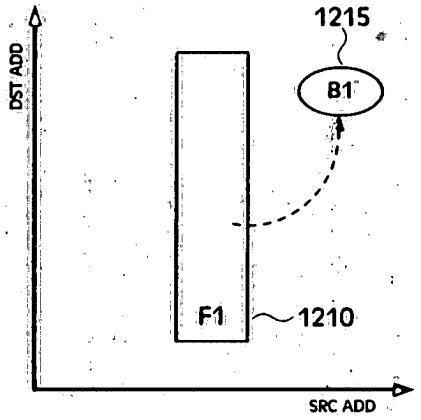

FIG. 12A

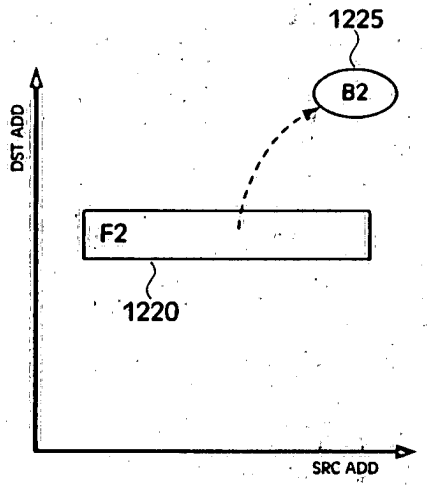

FIG. 12B

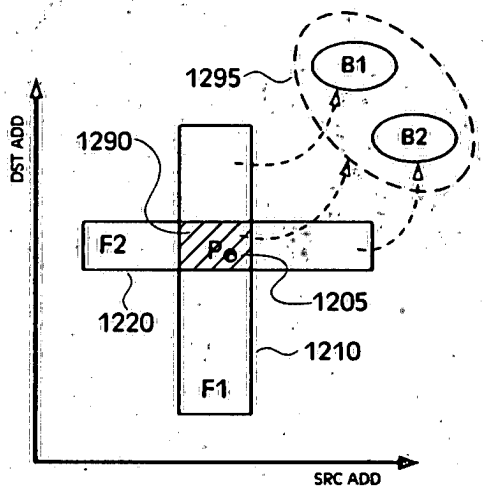

FIG. 12C

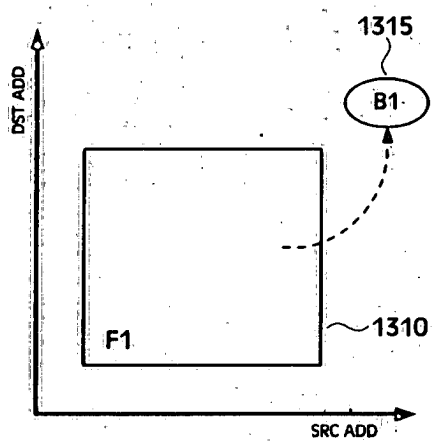

FIG. 13A

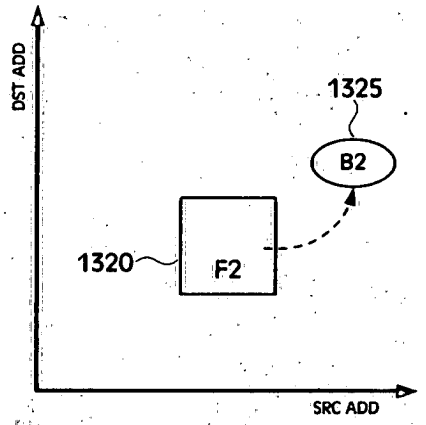

FIG. 13B

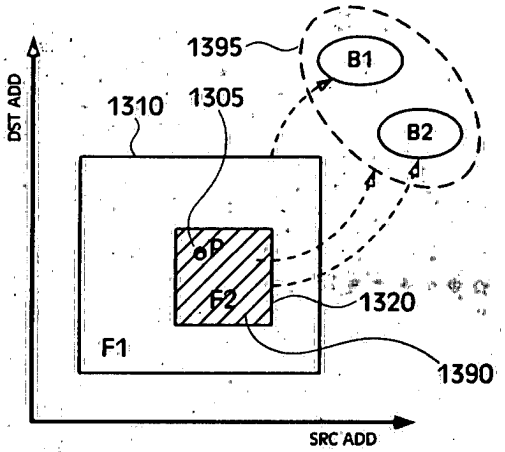

FIG. 13C

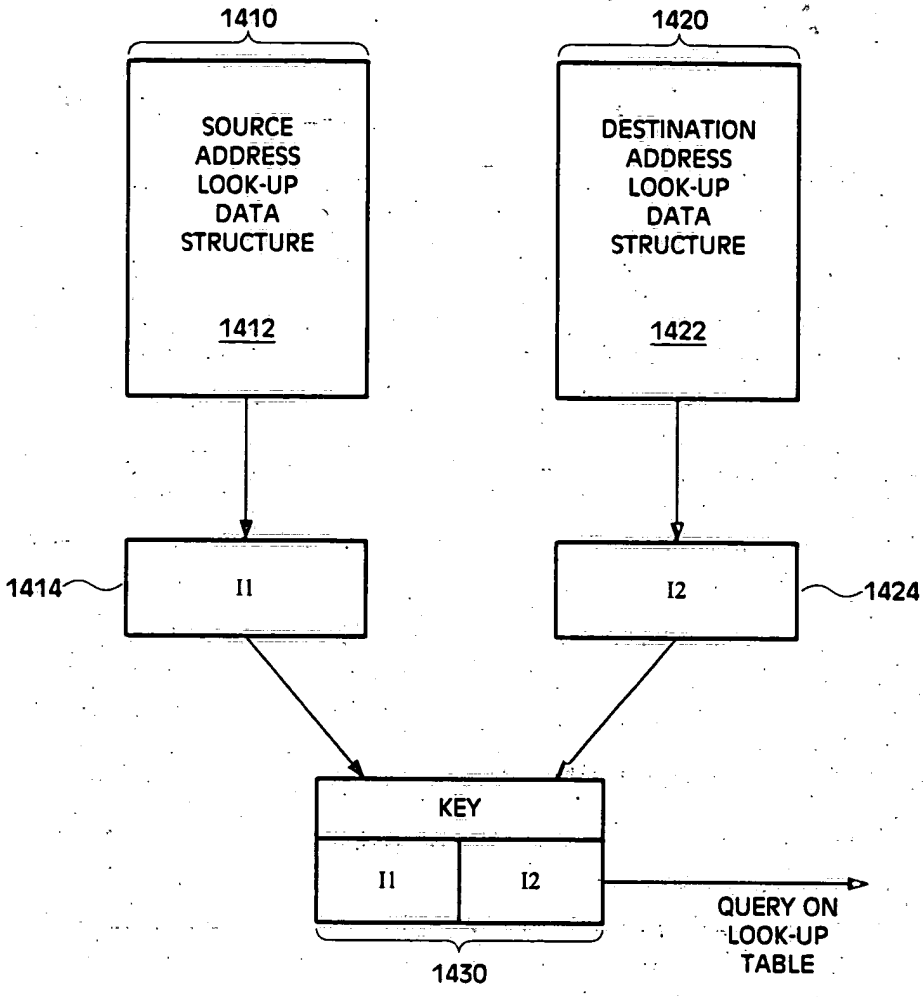
1410
SOURCE ADDRESS LOOK-UP DATA STRUCTURE
1412
1420
DESTINATION ADDRESS LOOK-UP DATA STRUCTURE
1422
1414
I1
I2
1424
KEY
I1
I2
QUERY ON LOOK-UP TABLE
1430

FIG. 14

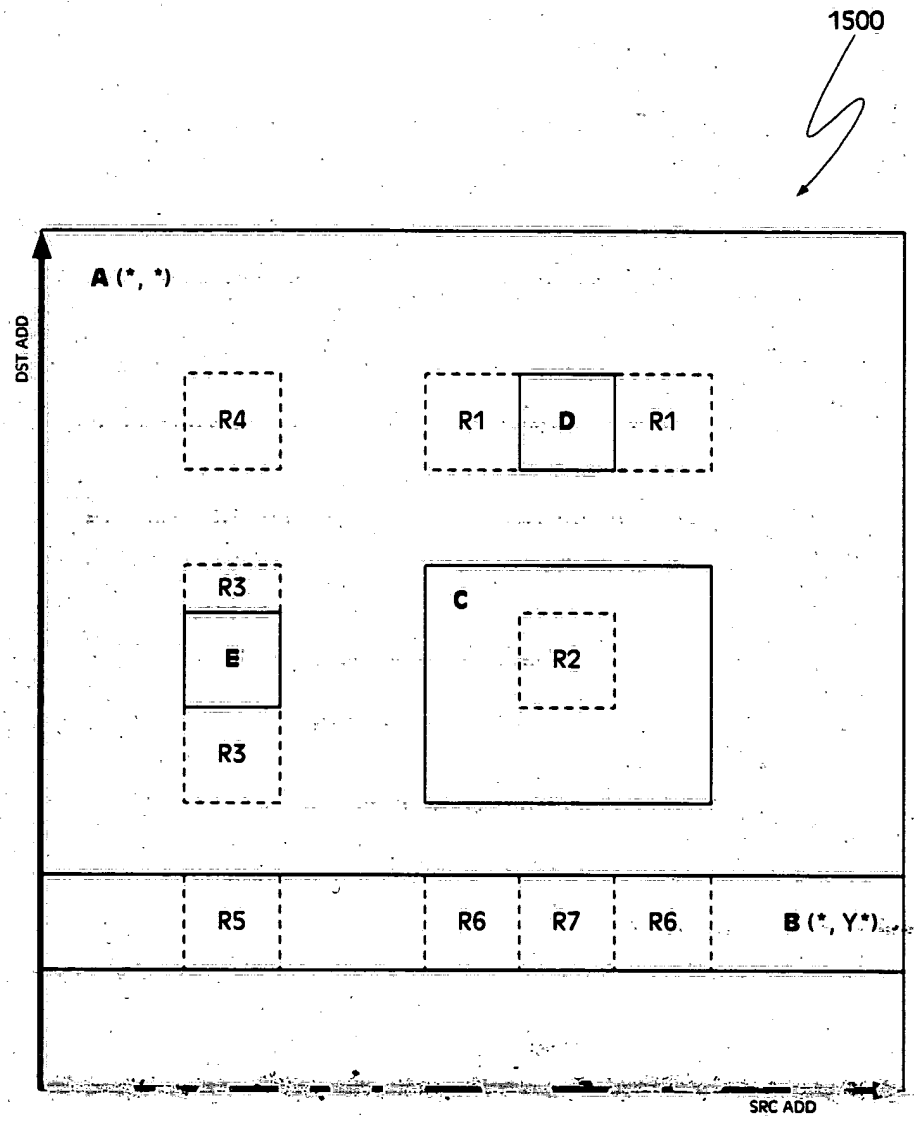

FIG. 15

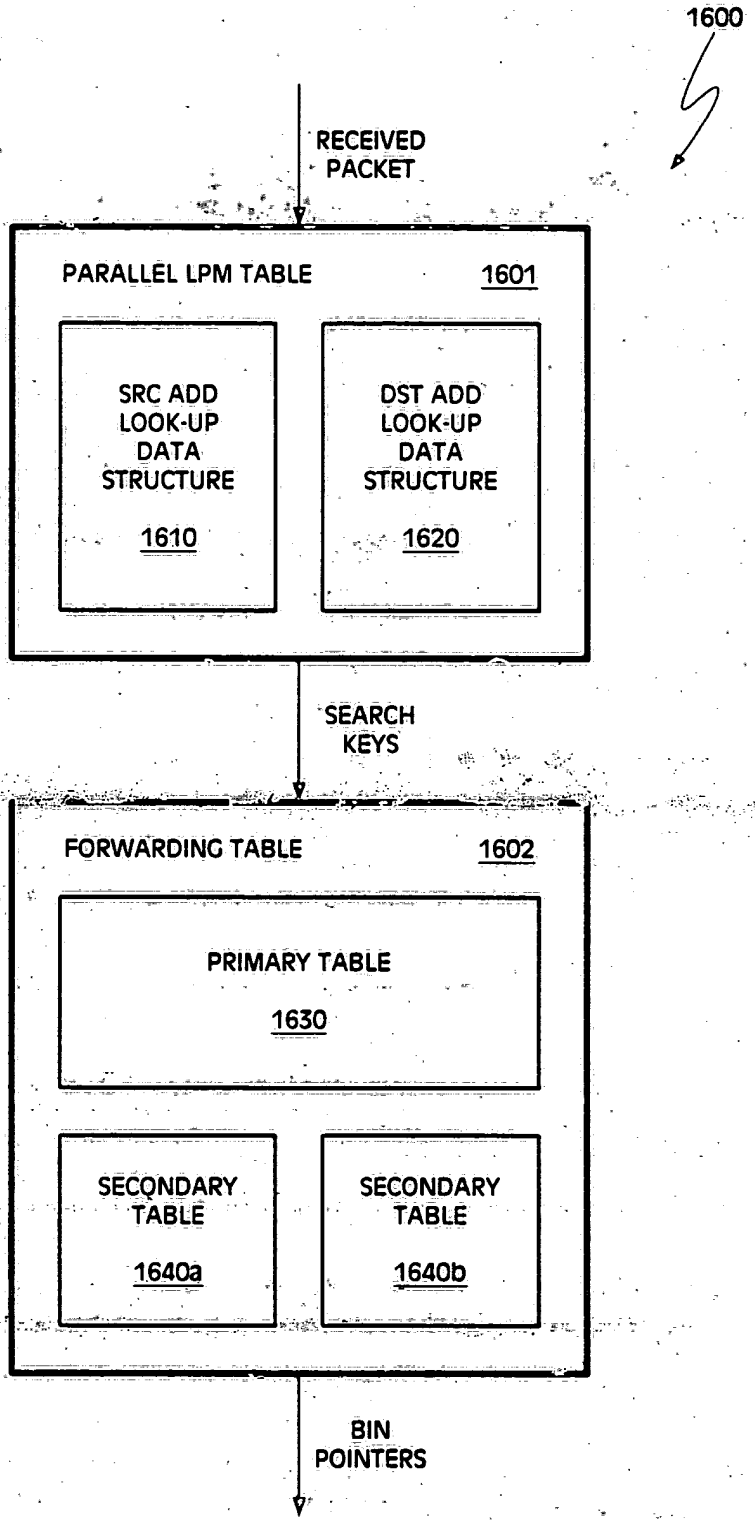
1600
RECEIVED PACKET
PARALLEL LPM TABLE
1601
SRC ADD LOOK-UP DATA STRUCTURE
1610
DST ADD LOOK-UP DATA STRUCTURE
1620
SEARCH KEYS
FORWARDING TABLE
1602
PRIMARY TABLE
1630
SECONDARY TABLE
1640a
SECONDARY TABLE
1640b
BIN POINTERS

FIG. 16A

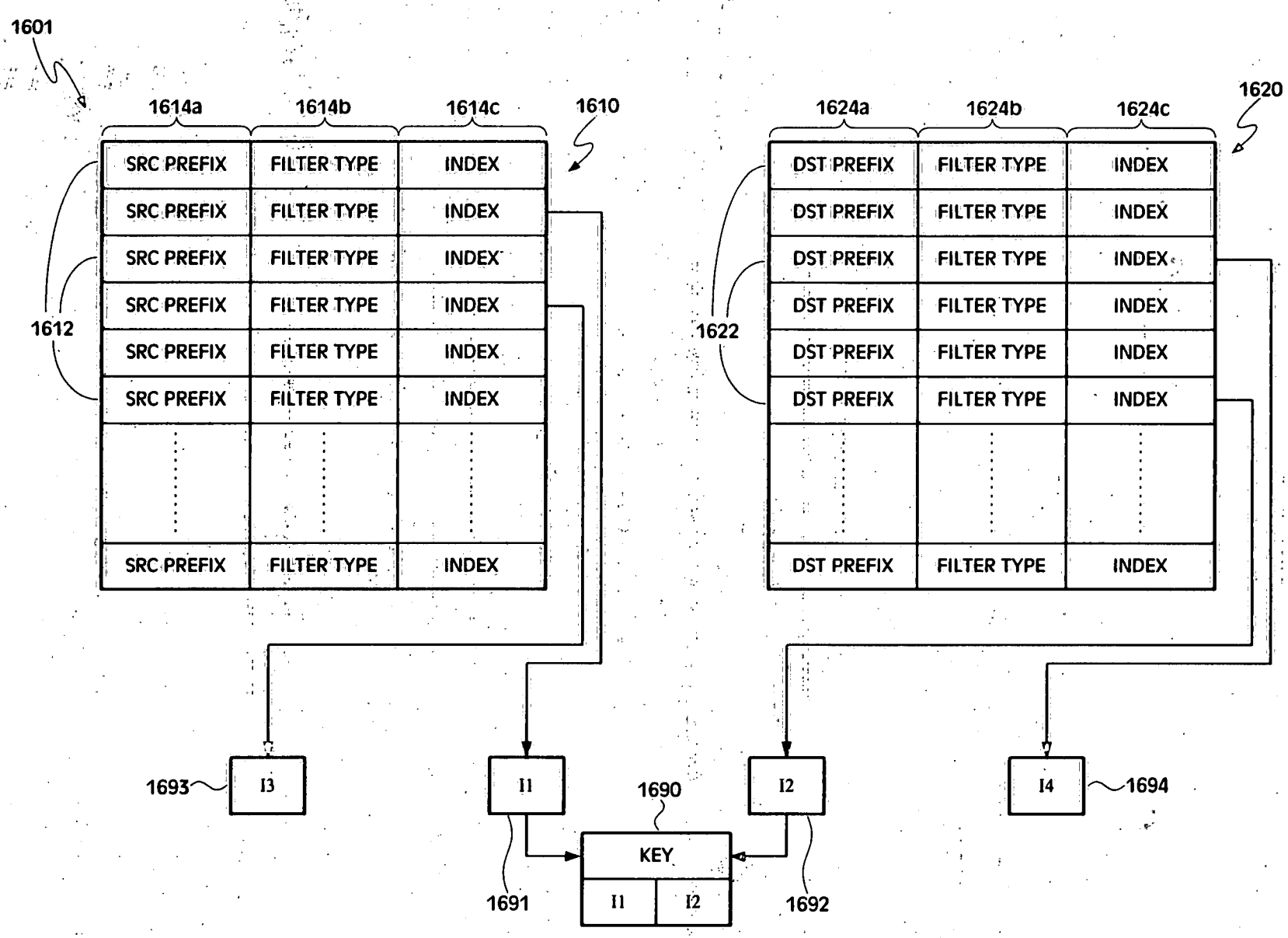
1601
1614a
1614b
1614c
1610
SRC PREFIX
FILTER TYPE
INDEX
1612
1620
1624a
1624b
1624c
DST PREFIX
1622
1693
I3
I1
1690
I2
I4
1694
KEY
1691
1692

FIG. 16B

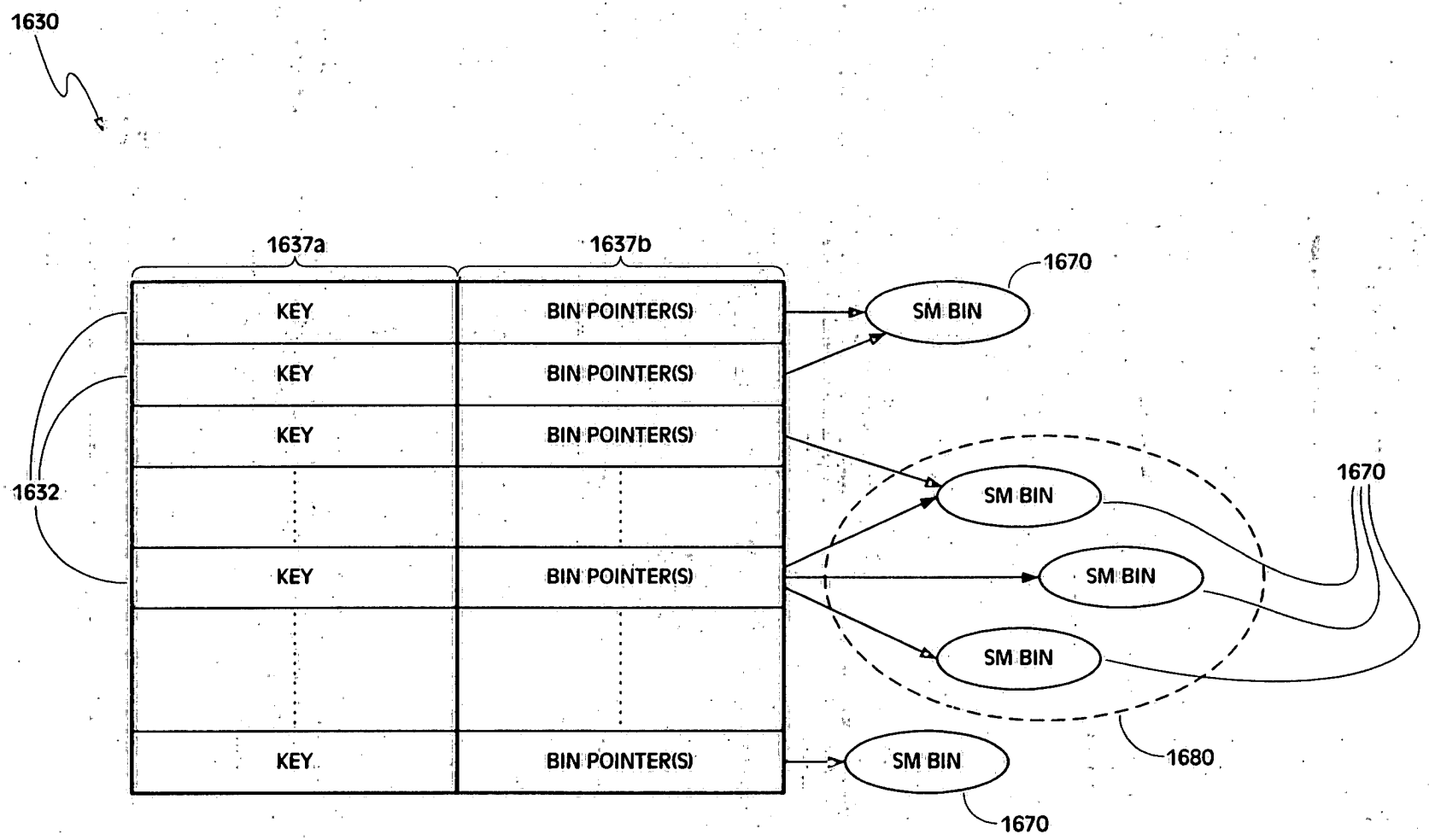

FIG. 16C

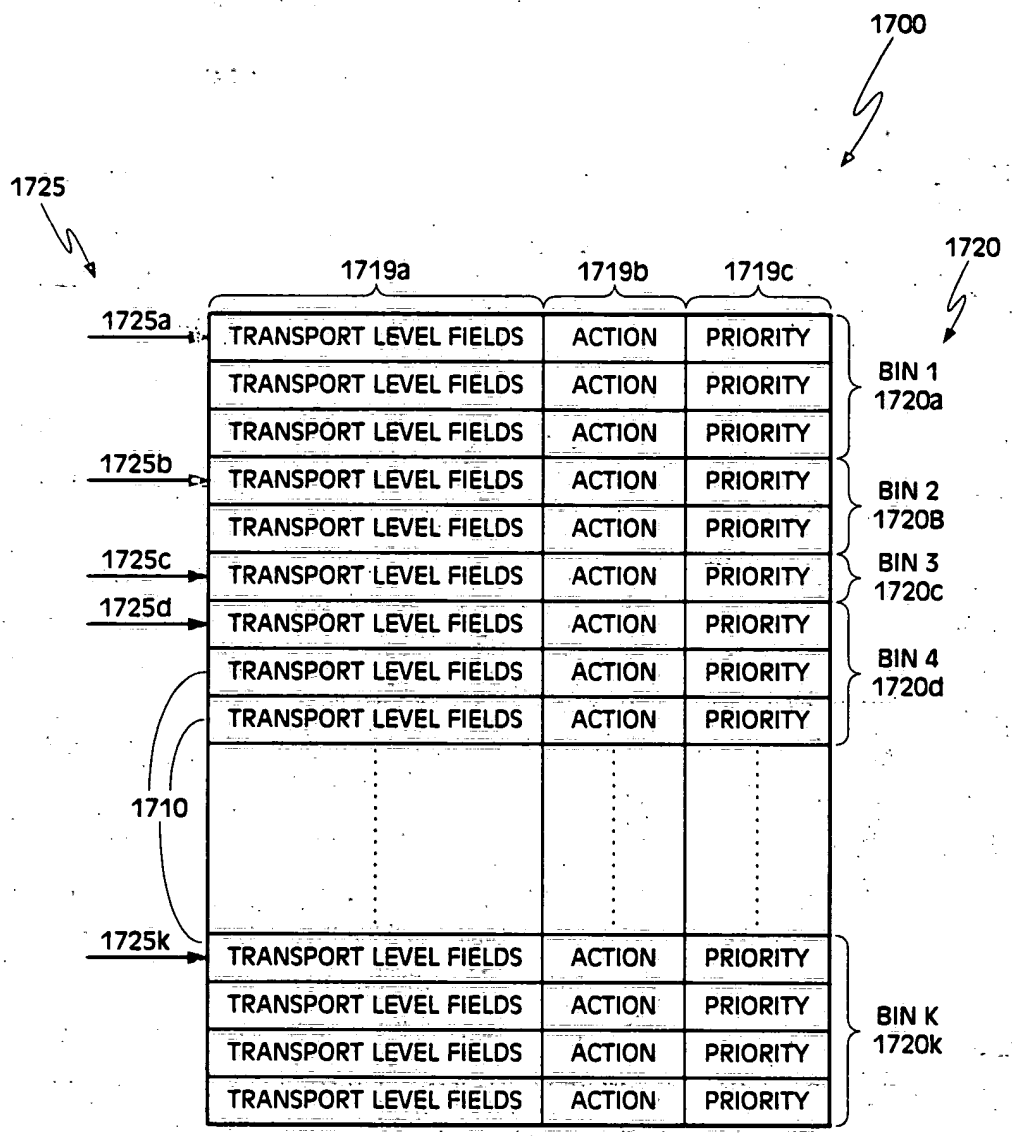
1700
1725
1720
1719a
1719b
1719c
1725a
1725b
1725c
1725d
1710
1725k
TRANSPORT LEVEL FIELDS
ACTION
PRIORITY
BIN 1
1720a
BIN 2
1720B
BIN 3
1720c
BIN 4
1720d
BIN K
1720k

FIG. 17

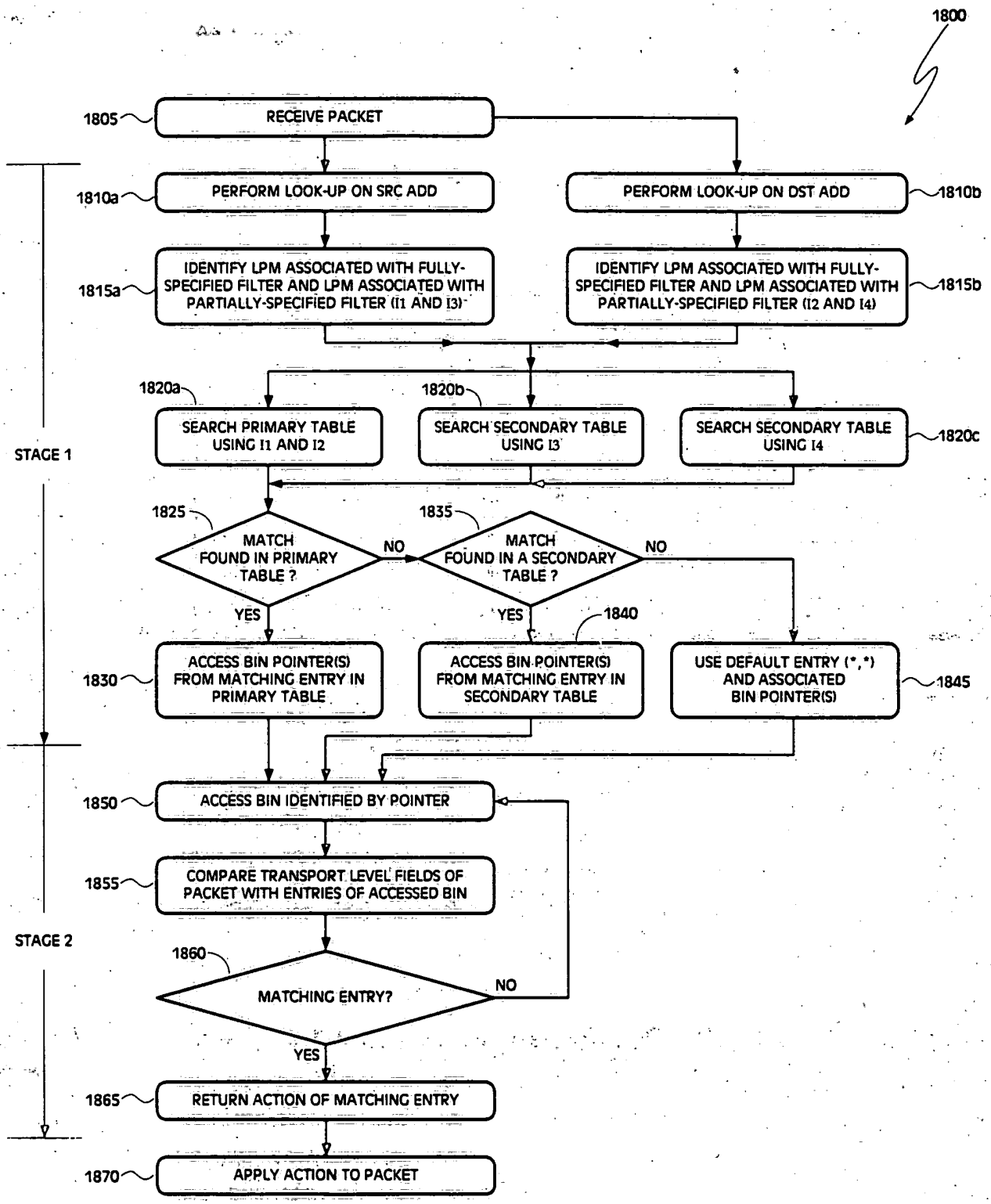
1800
1805
RECEIVE PACKET
1810a
PERFORM LOOK-UP ON SRC ADD
PERFORM LOOK-UP ON DST ADD
1810b
1815a
IDENTIFY LPM ASSOCIATED WITH FULLY-SPECIFIED FILTER AND LPM ASSOCIATED WITH PARTIALLY-SPECIFIED FILTER (I1 AND I3)
IDENTIFY LPM ASSOCIATED WITH FULLY-SPECIFIED FILTER AND LPM ASSOCIATED WITH PARTIALLY-SPECIFIED FILTER (I2 AND I4)
1815b
1820a
1820b
SEARCH PRIMARY TABLE USING I1 AND I2
SEARCH SECONDARY TABLE USING I3
SEARCH SECONDARY TABLE USING I4
1820c
STAGE 1
1825
MATCH FOUND IN PRIMARY TABLE ?
NO
1835
MATCH FOUND IN A SECONDARY TABLE ?
NO
YES
YES
1840
1830
ACCESS BIN POINTER(S) FROM MATCHING ENTRY IN PRIMARY TABLE
ACCESS BIN POINTER(S) FROM MATCHING ENTRY IN SECONDARY TABLE
USE DEFAULT ENTRY (*,*) AND ASSOCIATED BIN POINTER(S)
1845
1850
ACCESS BIN IDENTIFIED BY POINTER
1855
COMPARE TRANSPORT LEVEL FIELDS OF PACKET WITH ENTRIES OF ACCESSED BIN
STAGE 2
1860
MATCHING ENTRY?
NO
YES
1865
RETURN ACTION OF MATCHING ENTRY
1870
APPLY ACTION TO PACKET

FIG. 18

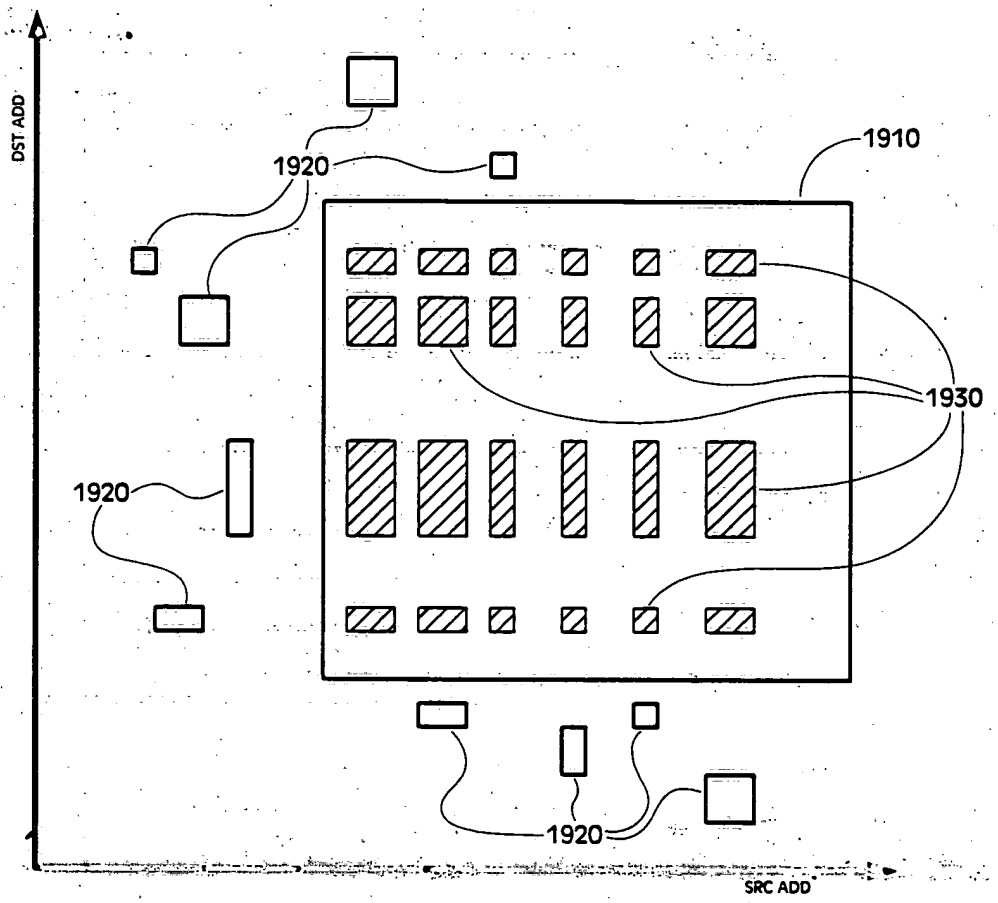

FIG. 19

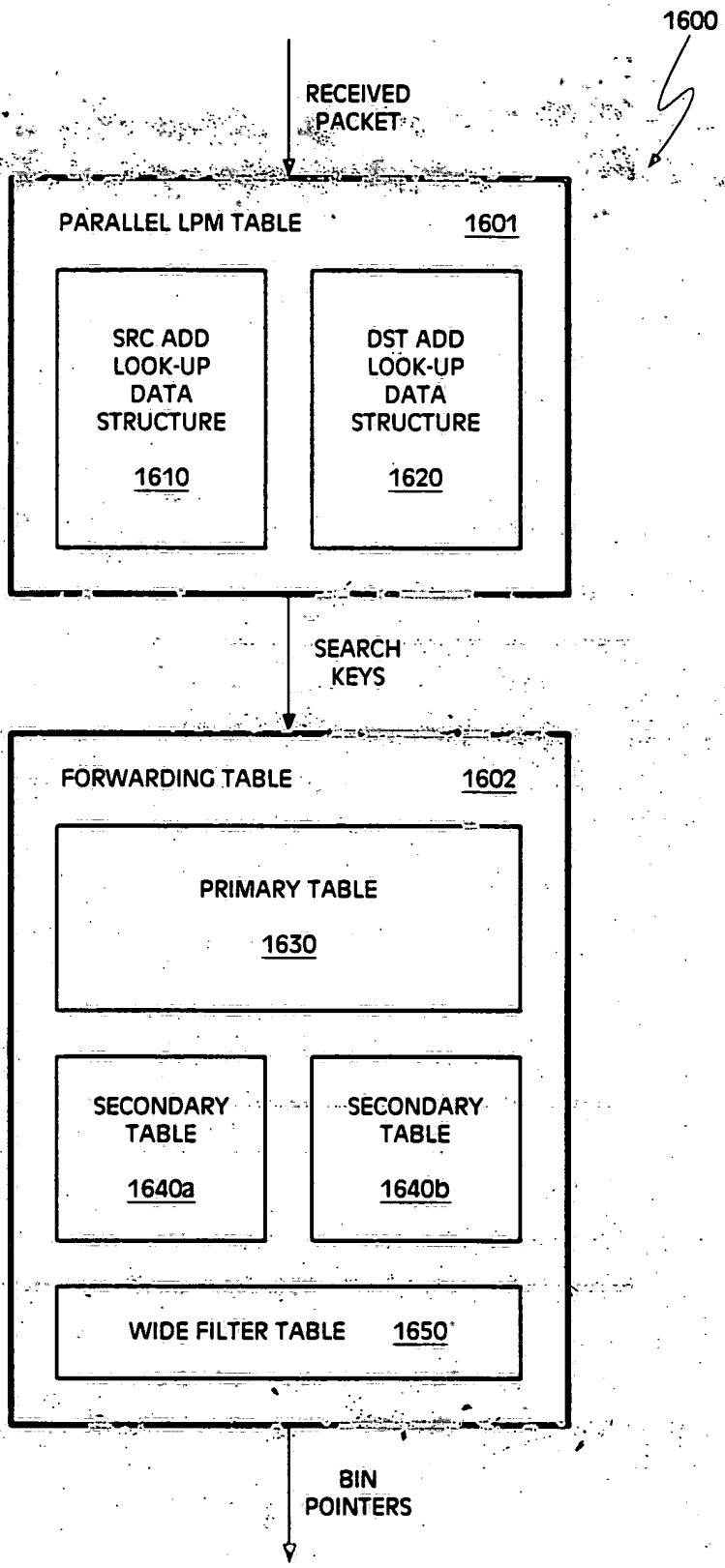
1600
RECEIVED PACKET
PARALLEL LPM TABLE 1601
SRC ADD LOOK-UP DATA STRUCTURE 1610
DST ADD LOOK-UP DATA STRUCTURE 1620
SEARCH KEYS
FORWARDING TABLE 1602
PRIMARY TABLE 1630
SECONDARY TABLE 1640a
SECONDARY TABLE 1640b
WIDE FILTER TABLE 1650
BIN POINTERS

FIG. 20A

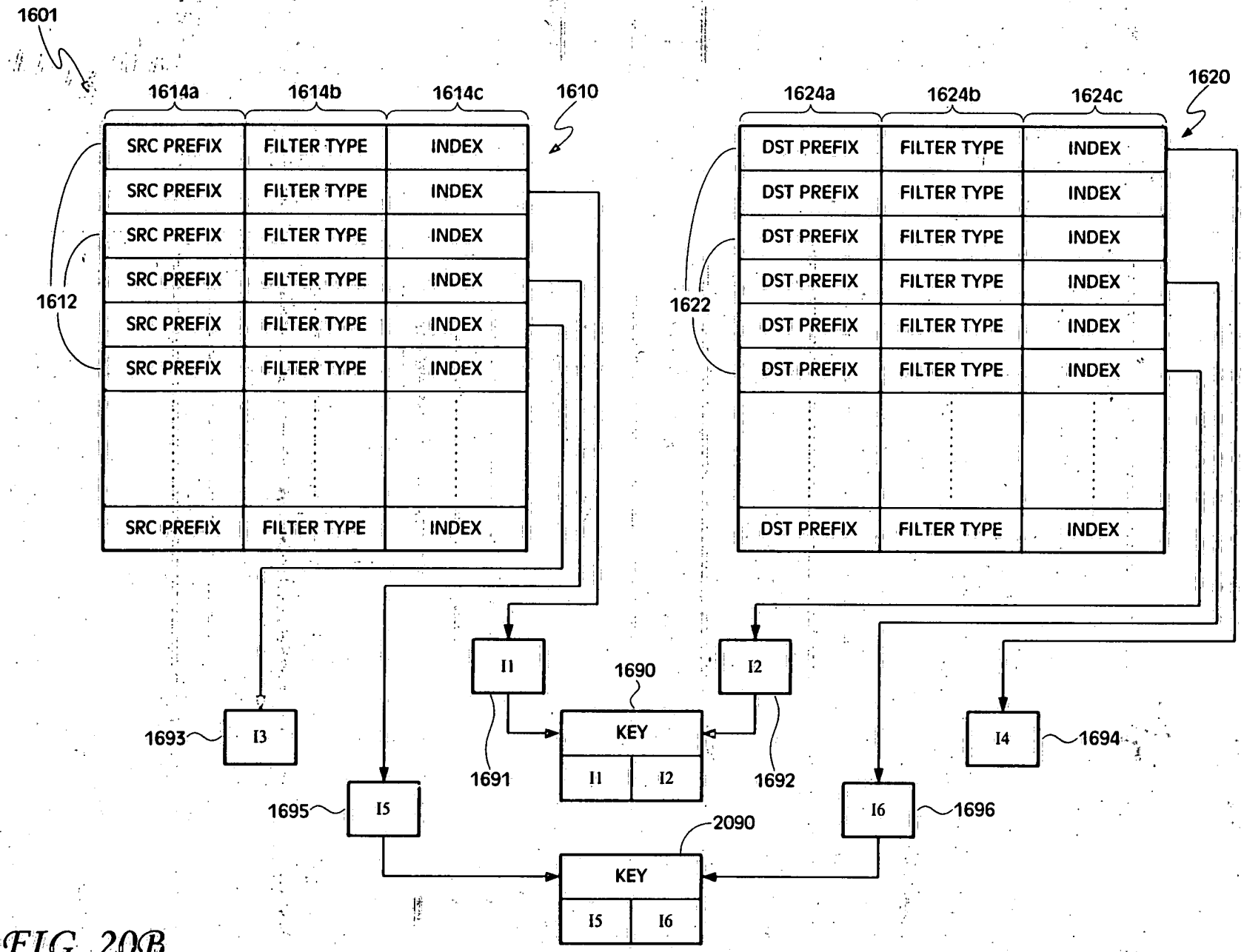
1601
1614a
1614b
1614c
1610
SRC PREFIX
FILTER TYPE
INDEX
1612
1620
1624a
1624b
1624c
DST PREFIX
1622
I1
I2
I3
I4
I5
I6
1690
KEY
1691
1692
1693
1694
1695
1696
2090

FIG. 20B

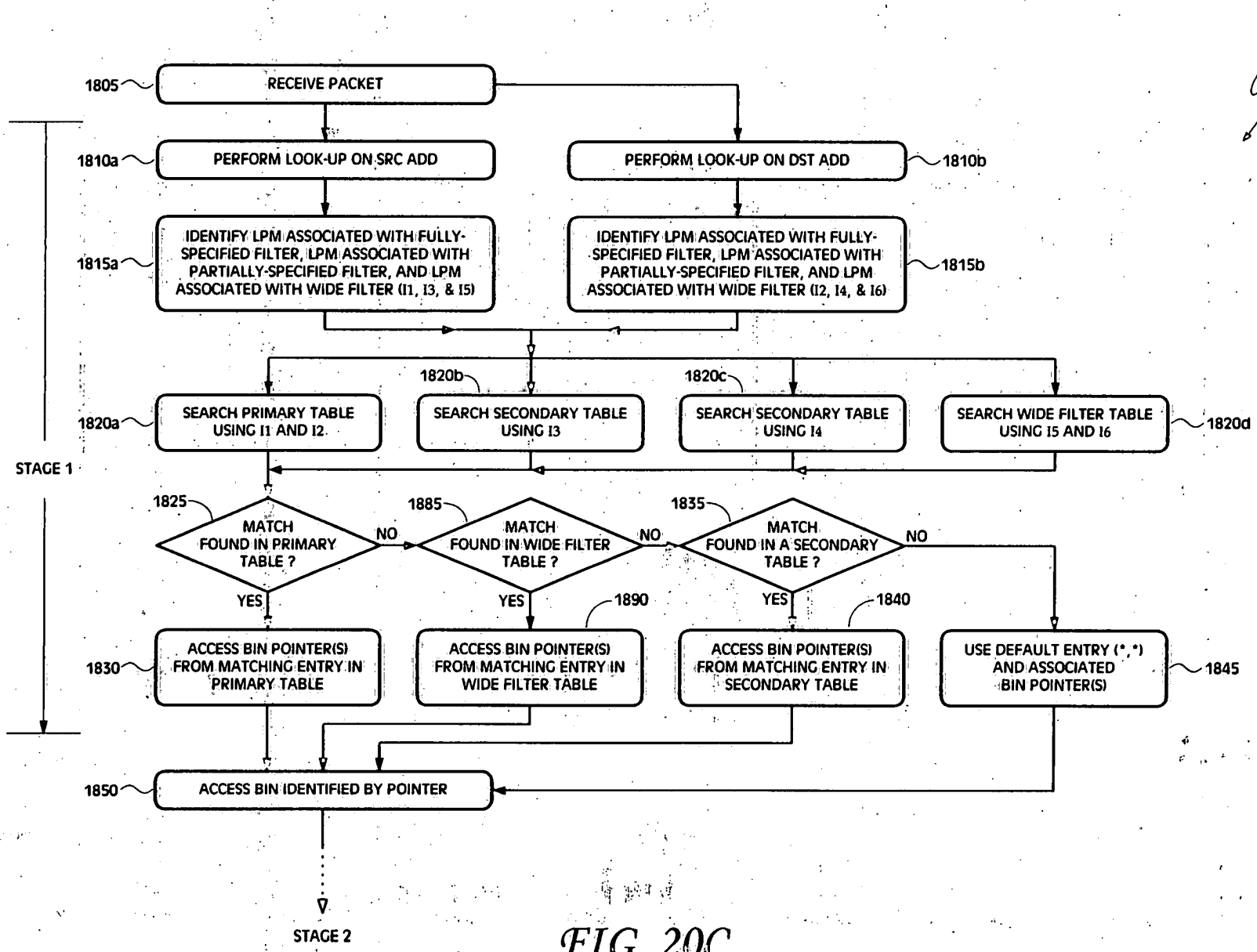
1800
1805
RECEIVE PACKET
1810a
PERFORM LOOK-UP ON SRC ADD
PERFORM LOOK-UP ON DST ADD
1810b
1815a
IDENTIFY LPM ASSOCIATED WITH FULLY-SPECIFIED FILTER, LPM ASSOCIATED WITH PARTIALLY-SPECIFIED FILTER, AND LPM ASSOCIATED WITH WIDE FILTER (I1, I3, & I5)
IDENTIFY LPM ASSOCIATED WITH FULLY-SPECIFIED FILTER, LPM ASSOCIATED WITH PARTIALLY-SPECIFIED FILTER, AND LPM ASSOCIATED WITH WIDE FILTER (I2, I4, & I6)
1815b
1820a
SEARCH PRIMARY TABLE USING I1 AND I2
1820b
SEARCH SECONDARY TABLE USING I3
1820c
SEARCH SECONDARY TABLE USING I4
SEARCH WIDE FILTER TABLE USING I5 AND I6
1820d
STAGE 1
1825
MATCH FOUND IN PRIMARY TABLE ?
NO
1885
MATCH FOUND IN WIDE FILTER TABLE ?
NO
1835
MATCH FOUND IN A SECONDARY TABLE ?
NO
YES
YES
1890
YES
1840
1830
ACCESS BIN POINTER(S) FROM MATCHING ENTRY IN PRIMARY TABLE
ACCESS BIN POINTER(S) FROM MATCHING ENTRY IN WIDE FILTER TABLE
ACCESS BIN POINTER(S) FROM MATCHING ENTRY IN SECONDARY TABLE
USE DEFAULT ENTRY (*,*) AND ASSOCIATED BIN POINTER(S)
1845
1850
ACCESS BIN IDENTIFIED BY POINTER
STAGE 2

FIG. 20C

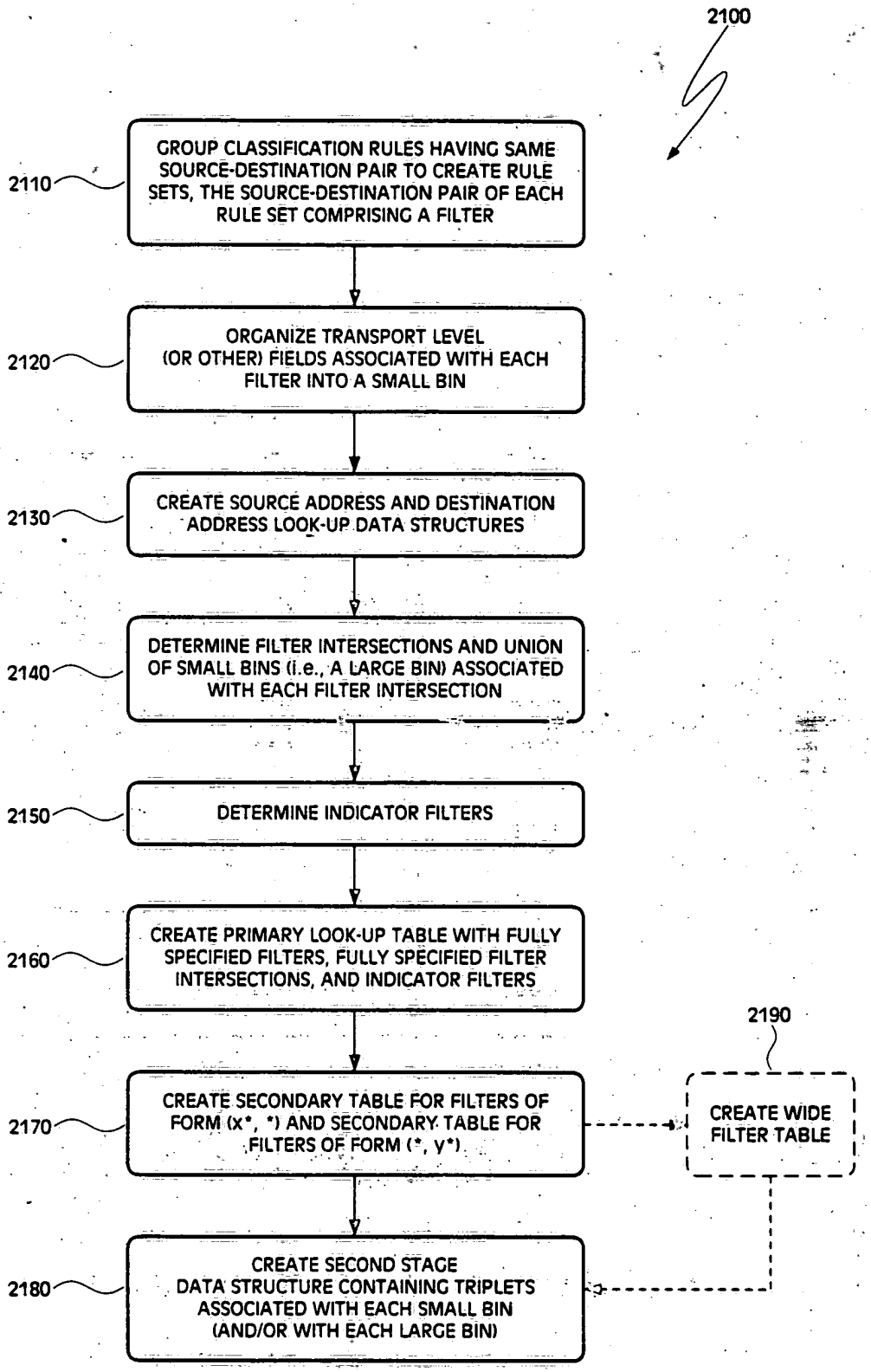
2100
2110
GROUP CLASSIFICATION RULES HAVING SAME SOURCE-DESTINATION PAIR TO CREATE RULE SETS, THE SOURCE-DESTINATION PAIR OF EACH RULE SET COMPRISING A FILTER
2120
ORGANIZE TRANSPORT LEVEL (OR OTHER) FIELDS ASSOCIATED WITH EACH FILTER INTO A SMALL BIN
2130
CREATE SOURCE ADDRESS AND DESTINATION ADDRESS LOOK-UP DATA STRUCTURES
2140
DETERMINE FILTER INTERSECTIONS AND UNION OF SMALL BINS (i.e., A LARGE BIN) ASSOCIATED WITH EACH FILTER INTERSECTION
2150
DETERMINE INDICATOR FILTERS
2160
CREATE PRIMARY LOOK-UP TABLE WITH FULLY SPECIFIED FILTERS, FULLY SPECIFIED FILTER INTERSECTIONS, AND INDICATOR FILTERS
2190
2170
CREATE SECONDARY TABLE FOR FILTERS OF FORM (x*, *) AND SECONDARY TABLE FOR FILTERS OF FORM (*, y*)
CREATE WIDE FILTER TABLE
2180
CREATE SECOND STAGE DATA STRUCTURE CONTAINING TRIPLETS ASSOCIATED WITH EACH SMALL BIN (AND/OR WITH EACH LARGE BIN)

FIG. 21